



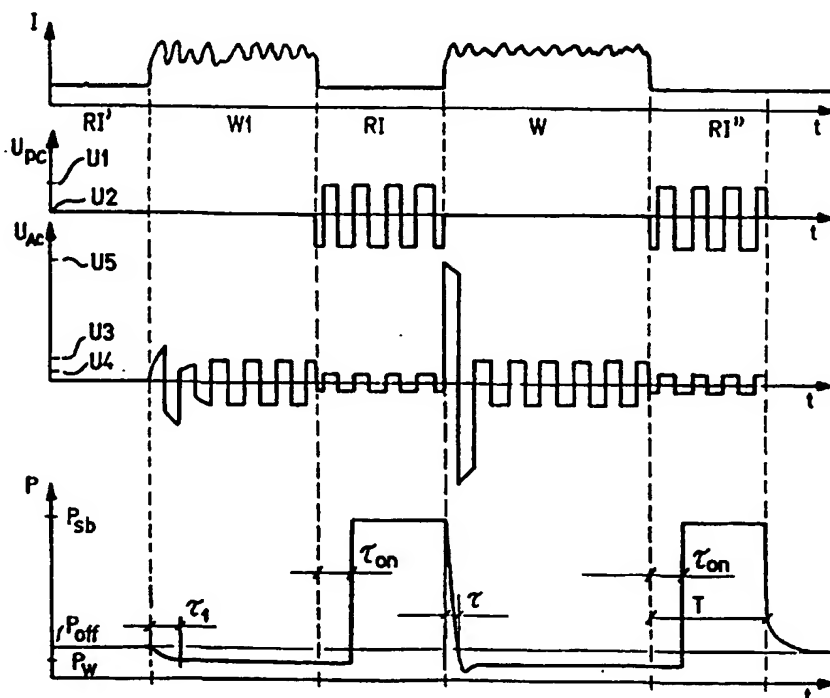
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: METHOD OF AUTOMATICALLY CONTROLLING A LIQUID CRYSTAL LIGHT TRANSMISSION MODULATOR OF WELDING PROTECTIVE GLASSES

## (57) Abstract

In accordance with the method of the invention to automatically control a liquid crystal light transmission modulator of welding protective glasses, across an active liquid crystal cell, when welding starts, a high transient control voltage ( $U_{AC}$ ) of the fifth level ( $U_5$ ) of an alternating polarity and of a varying amplitude is applied, which in several milliseconds from its initial value exceeding the optical threshold voltage of the active cell for an order of magnitude, drops to the control voltage of the third level ( $U_3$ ). In several hundred microseconds the transmission of the protective glasses drops for 95 % of the transmission ( $P_{sb}$ ) in the open state. After the termination of a welding flash, on the active cell there is the control voltage ( $U_{AC}$ ) of the fourth level ( $U_4$ ) of an alternating polarity and a constant amplitude and is slightly below the optical threshold voltage of the active cell.



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METHOD OF AUTOMATICALLY CONTROLLING  
A LIQUID CRYSTAL LIGHT TRANSMISSION MODULATOR  
OF WELDING PROTECTIVE GLASSES

BACKGROUND OF THE INVENTION

*Technical Field*

This application relates generally to safety devices specially designed for welding.

*Description of the Prior Art*

Methods of automatically controlling a liquid crystal light transmission modulator of known welding protective glasses essentially consist in making an attempt to turn on a light switch in response to the start of welding. Furthermore, the methods concentrate on the task to simultaneously reduce the probability of turning on the light switch due to the strong illumination of a place of work. The light switch is turned on by means of an infrared sensing element combined with a visible light sensing element (US 4,039,803) or by means of an infrared sensing element combined with an ultraviolet sensing element (EP 0 027 518 A1) or by a microphone or by a pair of microphones (US 4,241,286).

Known methods of automatically controlling a liquid crystal light transmission modulator of welding protective glasses essentially consist in the following. The liquid crystal light transmission modulator of welding protective glasses comprises a passive and an

active liquid crystal cell. Within a time interval following the termination of welding and shorter than the switching-off time of the welding protective glasses, a control voltage is applied across the passive liquid crystal cell amounting to the first control level of an alternating polarity and of a constant amplitude, which exceeds the optical threshold voltage of the passive liquid crystall cell. Thereby it is accomplished that the passive liquid crystall cell is in the state of a higher light transmission. Otherwise, however, across the passive liquid crystal cell during the welding as well as in the stand-by position of the welding protective glasses following the termination of welding after the lapse of the switching-off time, there is applied a control voltage amounting to the second control level, which is equal zero. Thus the passive liquid crystall cell is in the state of a lower light transmission. Across the active liquid crystal cell, however, during the welding there is applied a settable control voltage amounting to the third control level of an alternating polarity and of a constant amplitude, which exceeds the optical threshold voltage of the active liquid crystall cell.

Welding protective glasses themselves are provided either by semimechanical light switches (DE 30 17 241 A1) or by liquid crystal light switches (DE 33 32 083 A1, DT 25 53 976 A1, EP 0 349 665 A1, US 4,039,803, US 4,241,286, EP 0 027 518 A1, EP 0 091 514 B1).

Though some liquid crystal light transmission modulators (US 4,039,803 and EP 0 027 518 A1) comprise only one liquid crystal cell, they are preferably provided with one one passive and one or several active liquid crystal cells (EP 0 091 514 B1 and F 22 93 188) placed one behind the other. The latter liquid crystal light transmission modulators as compared to the former ones stronger attenuate the incident light and secure a more suitable angular distribution of the transmitted light.

The light switches comprised within the afore-said welding protective glasses are provided with an autonomous battery power supply, some of them (EP 0 349 665 A1 and EP 0 091 514 B1), however, are provided with a semiconductor solar cell in order to extend the operating life of the power supply battery.

A deficiency of known methods of automatically controlling a liquid crystal modulator exists above all in the dynamics of the switching liquid crystal light transmission modulators which at highest safety degrees of shielding do not completely satisfy the safety regulations (DIN 4647/7). It is true of all liquid crystal light transmission modulators that their electrooptical response time is strongly temperature-dependent. Since liquid crystal properties, especially the viscosity, strongly change with the temperature, no one of the above liquid crystal modulators controlled in a hitherto known way at temperatures below +5 °C satisfies the safety regulations at the highest degrees of shielding (degrees 12 and 13).

Moreover, it is considered as another deficiency of the method of controlling the liquid crystal modulator of known welding protective glasses that they have to be turned on by a mechanical switch and that also the supply battery check has to be actuated by a separate mechanical switch. No one of the methods of controlling the liquid crystal modulator of said welding protective glasses completely solves the posed technical problem.

### SUMMARY OF THE INVENTION

In accordance with the foregoing background discussion, the object of this invention is to provide a method of automatically controlling the liquid crystal modulator of welding protective glasses, which method will make possible that by a multilevel automatic control of the liquid crystal modulator within the light switch, so short switching times thereof will be achieved that at the highest safety degrees of shielding it will satisfy the requirements posed by DIN 4647/7. Additionally, the method of automatically controlling the light switch has to guarantee that the light switch will be turned on automatically at the start of welding and that by properly shaped control voltages across the modulator liquid crystal cells the electric energy consumption will be substantially reduced and that by an automatic battery check a darkening of the welding protective glasses takes place, whenever the power supply battery is worn out.

With the foregoing objects in view, the method of automatically controlling the liquid crystal light transmission modulator of welding protective glasses in accordance with the invention is characterized by the features of the characterizing portion of claims 1 to 4.

Advantageously, the inventive method of automatically controlling the liquid crystal light transmission modulator makes it possible that light transmission of the welding protective glasses is reduced for at least 95 % within several hundred microseconds or in a time interval shorter than 1 ms after the welding flash has appeared. Accordingly, the dynamics of the electrooptical response within the whole temperature region of the operation of the liquid crystal modulator regulating the light transmission satisfies the welding safety regulations (DIN 4647/7), also for the degrees 12 and 13 of shielding. Advantageously, the liquid crystal modulator is controlled so that the welding protective glasses are darkened whenever the battery voltage drops below an allowable value, whereby in the case of a worn out power supply voltage source the passive safety is afforded. By the control voltages across the active and the passive cell of the liquid crystal modulator at every polarity inversion continuing to be zero until the electric charge from the cell plates returns to a feeding capacitor in the light switch circuit, the consumption of electrical energy is reduced by well over 50 %.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings,

Fig. 1 represents a light switch within welding protective glasses for carrying out the method according to the invention,

Fig. 2 a control circuit of the active and the passive liquid crystal cell within the light switch of Fig. 1,

- Fig. 3 are graphs vs time of the luminance of a place of work and of the control voltages across the active and the passive liquid crystal cell and of the light transmission of welding protective glasses, to which the method according to the invention is applied,
- Fig. 4 represents a further embodiment of a driver circuit of the active and the passive liquid crystal cell within the light switch of Fig. 1,
- Fig. 5 is a graph of a preferred time dependence of the control voltages across the active and the passive cell at their polarity inversions.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

By the method according to the invention a liquid crystal light transmission modulator LAM of welding protective glasses is controlled automatically in a multilevel mode (Fig. 1). The liquid crystal light transmission modulator LAM is comprised within a light switch, whose circuit is shown in Fig. 1, and is composed of a passive liquid crystal cell PC and one or several active liquid crystal cells AC situated one behind the other.

A control voltage  $U_{PC}$  of an alternating polarity and of a constant amplitude amounting to the first control level  $U_1$  is applied across the passive liquid crystal cell PC within a time  $\tau_{on}$  after the termination of the welding flash of any welding, i. e. in the time intervals  $RI$ , when the luminance  $I$  of a place of work is determined by the lighting conditions in the room (Fig. 3).. The voltage of the first control level  $U_1$  exceeds the optical threshold voltage of the passive cell PC. Then the passive cell PC appears to be in the state of the highest light transmission. The control voltage  $U_{PC}$  of said first control level is maintained across the passive liquid crystal cell PC also in a time interval  $RI$  from the termination of the last welding flash up to the lapse of the switching-off time  $T$  (approximately 20 min) when the whole circuit of the light switch is automatically switched off.

During the welding flashes, i. e. within time intervals  $W1$ ,  $W$  in Fig. 3, and during the stand-by position of the welding protective glasses, i. e. within the time interval  $RI''$  after the lapse of the switching-off time  $T$  following the termination of the last welding flash, across the passive liquid crystal cell  $PC$  the control voltage  $U_{PC}$  of the second control level  $U2$  being equal zero is applied. Hence the passive liquid crystall cell  $PC$  is in the state of the lowest light transmission.

Across the active liquid crystal cell  $AC$  during time intervals  $W1$ ,  $W$ , in which the welding flashes appear, the adjustable control voltage  $U_{AC}$  of the third control level  $U3$  and of an alternating polarity is applied. Its amplitude is constant and exceeds the optical threshold voltage of the active liquid crystall cell  $AC$ .

Across the active liquid crystal cell  $AC$  within a time  $\tau_{on}$ , being of the order of magnitude of 10 ms, after each respective termination of the welding flash, i. e. within time intervals  $RI$ , there is applied the control voltage  $U_{AC}$  amounting to the fourth control level  $U4$  of an alternating polarity and of a constant amplitude. Its amplitude is slightly below the optical threshold voltage of the active liquid crystall cell  $AC$ . Such control voltage  $U_{AC}$  is applied across the active liquid crystal cell  $AC$  also in the time interval  $RI''$ , however, only within the lapse of the switching-off time  $T$  following the termination of the last welding flash.

At the very beginning of the welding, which follows the termination of the previous welding after a time interval being shorter than the switching-off time  $T$ , i. e. at the beginning of the time interval  $W$ , across the active liquid crystal cell  $AC$  a momentary control voltage  $U_{AC}$  appears amounting to the fifth control level  $U5$  of an alternating polarity and of a varying amplitude. Very rapidly the control voltage amplitude increases to its initial value  $U5$  exceeding the optical threshold voltage of the active liquid crystall cell  $AC$  for an order of magnitude and in several milliseconds thereafter drops to the amplitude of the third control level  $U3$ .



According to a preferred embodiment the control voltage  $U'_{AC}$ ,  $U'_{PC}$  across the active and the passive liquid crystal cell AC, PC, respectively, each time at its polarity inversion continues to be zero for a time interval  $\tau'$  (Fig. 5) until the total electric charge from the plates of the active and passive liquid crystal cell AC, PC flows back to a feeding capacitor in the light switch circuit.

According to the method of invention the whole control circuit of the light switch is turned on as soon as the first welding flash appears at the beginning of the first welding time interval W1 after a longer lapse of time (time interval RI') after the previous welding. For this reason, at the very beginning of the first welding time interval W1 the control voltage  $U_{AC}$  across the active liquid crystal cell AC does not reach the initial value, which would exceed the optical threshold voltage of the active liquid crystal cell AC for an order of magnitude and yet it exceeds the amplitude of the third control level U3 (Fig. 3).

According to the method of the invention the control voltage  $U_{PC}$  across the passive liquid crystal cell drops to zero whenever the power supply battery of the light switch gets worn out and thereby the passive liquid crystal cell PC passes over into the state of the lowest light transmission.

Since at the very beginning of the first welding time interval W1, the control voltage  $U_{AC}$  does not reach the high voltage of the fifth control level U5, at the beginning of the welding time interval W1 the light transmission P of the welding protective glasses is reduced from the light transmission  $P_{off}$  in the time interval RI' for 95 %, attaining the value  $P_w$  in the course of time  $\tau_1$ , which is of the order of magnitude of 10 ms. In the time intervals RI and up to the lapse of the switching-off time T in the time interval RI' the welding protective glasses are in a standby state and their light transmission  $P_{sb}$  is higher, for about 50 times, than the light transmission  $P_{off}$ , therefore the place of work can be seen well through welding protective glasses already at the lighting conditions present in the room of work. The high voltage of the fifth control level U5 established at the beginning of the time intervals W across the active liquid crystal cells AC makes possible that the light transmission P of the welding protective glasses is reduced for 95 % in a very short time  $\tau$ , which amounts to several hundred microseconds and is  $\leq 1$  ms at

-10 °C. Actually, the light transmission  $P$  of the welding protective glasses immediately after time  $\tau$  following the start of the welding flash even drops a little below the value  $P_w$  for several milliseconds.

The light switch for carrying out the method of automatically controlling the liquid crystal light transmission modulator of welding protective glasses is composed of a control circuit and of the liquid crystal light transmission modulator LAM (Fig. 1).

The static light transmission as regulated by the standard is achieved by the liquid crystal light transmission modulator LAM, which is composed of one passive liquid crystal cell PC and of one or several active liquid crystal cells AC.

The light is most strongly attenuated by the passive liquid crystal cell PC when the electric voltage  $U_{PC}$  across it is equal zero. The electrooptical response of the passive liquid crystal cell PC to abrupt changes of the amplitudes of the control voltage  $U_{PC}$ , i. e. the rate of the light transmission reduction, does not depend on the voltage  $U_{PC}$ . The passive liquid crystal cell must be thin and provided with a low viscosity liquid crystal since the rate of the light transmission reduction is inversely proportional to the thickness of the liquid crystal layer and to the liquid crystal viscosity. In the time intervals RI, when the light transmission of the passive liquid crystal cell PC should be as high as possible, the voltage  $U_{PC}$  is preferably above the optical threshold of the cell.

The light is attenuated by the active liquid crystal cell AC when the electric voltage  $U_{AC}$  across it differs from zero. The electrooptical response of the active liquid crystal cell AC to abrupt changes of the amplitude of the control voltage  $U_{AC}$ , i. e. the rate of the light transmission reduction or increase, is proportional to the value of the voltage  $U_{AC}$ . A very fast reduction of the light transmission at the beginning of the time intervals W is achieved by the control voltage  $U_{AC}$  of the fifth control level U5. A still faster response to the control voltage of this control level is achieved in that already in the time interval RI the control voltage  $U_{AC}$  is of the control level U3, hence a little below the optical threshold of the active liquid crystal cell AC.

The light switch is composed of a sensor and power supply circuit 1, an input amplifier 2, a logic control circuit 3, a testing circuit 4 to check a power supply battery, a voltage regulator 5, a selector switch 6, a driver 7, 8 of the active and passive liquid crystal cell, respectively, whereto the liquid crystal light transmission modulator LAM is connected, a counter C and an oscillator O.

In the sensor and power supply circuit 1 the emitter terminal of the phototransistor PT1 is connected on the one hand to a turn-on input 1on of a voltage converter VC1 and through a resistor R1 to a power supply battery B1 and to one of the feeding terminals of the voltage converter VC1 and on the other hand to the noninverting input of an amplifier A2 within the input amplifier 2. The sliding terminal of a potentiometer P2, the fixed terminals of which are connected to the supply voltage of the circuit and to the ground, is connected to the inverting input of the amplifier A2, the output of which is connected to the mutually connected inputs of the NAND gate G31 in the logic control circuit 3. The output of the NAND gate G31 is connected to the output 3c of the logic control circuit 3 and to the mutually connected inputs of the NAND gate G32, the output of which is connected to the output 3a of the logic control circuit 3 and to a capacitor C3, the second terminal of which is connected to the output 3b of the circuit 3 and through a resistor R3 to the ground. The output 3a of the logic control circuit 3 is connected to the reset input Cr of the counter C, whose output Co is connected through a NAND gate G33, whose inputs are mutually connected, to the off-input 1off of the voltage converter VC1.

The feeding terminals of the circuits within the light switch are connected to the low voltage output 1l of the voltage converter VC1.

Within the selector switch 6 the output 3b of the logic control circuit 3 is connected, through a resistor R6 and through a switching transistor T61, to the base of a switching transistor T62, whose emitter is connected to the high voltage output 1h of the voltage converter VC1 and the collector is connected through the output terminal 6a of the selector switch 6 to the feeding terminal 7a of the driver 7 of the active liquid crystal cell AC.

At the same time the output 3b of the logic control circuit 3 is also connected to the reset input Or of the oscillator O, the clock output Ocl of which is connected to the clock input Ccl of the counter C and to the clock input 7b, 8b of the driver 7, 8 of the active and passive liquid crystal cell AC, PC, respectively.

Within the voltage regulator 5 the output 3c of the logic control circuit 3 is connected, through an adjustable resistor R51 and a diode D5, to the inverting input of the operational amplifier A5, the noninverting input of which is connected to a reference voltage of a Zener diode ZD, which is connected through a resistor R to the supply voltage generated at the low voltage output 1l of the voltage converter VC1. The inverting input of an operational amplifier A5 is connected through a temperature-dependent (NTC) resistor 53 to the amplifier output, which is connected through a diode D6 to the output 6a of the selector switch 6. The output 6a is connected to a capacitor C6, the second terminal of which is connected to the ground.

The output 3c of the logic control circuit 3 is connected through a resistor R43 to the noninverting input of an operational amplifier A4, the positive feedback of which is realised by a resistor R44 and the noninverting input of which is connected to the terminal of the Zener diode ZD and the output of which is connected to the control terminal 8c of the driver 8 of the passive liquid crystal cell PC.

Within the testing circuit 4 for checking the power supply battery, the low voltage output 1l is, through series-connected resistors R41, R42, connected to the ground and the common terminal of the resistors R41, R42 is connected to the noninverting input of the operational amplifier A4.

In Fig. 2 the drivers 7, 8 of the active and passive liquid crystal cell AC, PC, respectively, are shown. The driver 7 makes possible by transistors T71, T72, resistors R71, R72 and transistors T73, T74 that also the high control voltage  $V_{AC}$  of the varying polarity is supplied to the plates of the active liquid crystal cell AC. The control voltage  $U_{PC}$  of the varying polarity is prepared by the driver 8 composed of exclusive NOR gates G81, ..., G84.

In Fig. 4 a preferred embodiment of the drivers 7', 8' of the active and passive liquid crystal cell AC, PC, respectively, is shown. Transistors T71', ..., T74', connected to circuits AS1', AS2' directly or through circuits LSI71', LSI72' for inverting and shifting levels, operate as analogue switches and connect the plates of the active liquid crystal cell AC to appropriate control voltages as dictated by two square-wave signals mutually displaced by a half-period in which signals, however, the duration of the first level exceeds the duration of the second level for a time interval  $2\tau'$ , which is achieved by setting a resistor and a capacitor within circuits AS1', AS2'. By an appropriate selection of the time interval  $\tau'$  it is achieved that at each polarity inversion of the control voltage  $U_{AC}$  the electric charge from the plates of the liquid crystal cell AC is returned to feeding capacitors C71', C72' whereat resistors R71', R72' provide for a correct directing of the electric discharging current. A controlling of the passive liquid crystal cell PC proceeds similarly. The gates GA3', GA4' within circuits AS3', AS4', the outputs of which are connected to the plates of the passive liquid crystal cell PC, have to belong to two different logic integrated circuits. This makes possible to use a resistor cross-over network as represented by resistors R71', R72' and to have separated feeding capacitors C71', C72' within the driver 7' for the active liquid crystal cell AC. Due to remarkable energy savings, the drivers 7', 8' of Fig. 4 are most appropriate for large liquid crystal displays in liquid crystal light transmission modulators, in personal computers, electronic books and so forth.

The welding flash is sensed by the phototransistor PT1, which turns on the voltage converter VC1, whereby the whole circuit of the light switch is turned on. Whenever a welding flash appears, an impulse appears on the output 3b of the logic control circuit 3 resetting the oscillator O. Furthermore, the impulse on the output 3b of the logic control circuit 3 for the time of its duration opens the transistor T62 and therefore on the output 6a of the selector switch 6 a high voltage appears. In the time intervals W, when the power supply is already turned on due to previous flashes, this high voltage reaches the control level U5. During the actual welding the voltage on the output 3c of the logic control circuit 3 determines the voltage on the output 6a of the selector switch 6 by means of the adjustable resistor R51 and the amplifier A5. This voltage determines the control voltage  $U_{AC}$  across the active liquid crystal cell AC and, after the expiration of the duration time of the control level U5, i. e. after some milliseconds, corresponds to

the control level U3. At the same time through the resistor R43 and the amplifier A4 the output 3c determines the control level on the terminal 8c of the driver 8 so that the amplitude of the control voltage  $U_{PC}$  drops to zero.

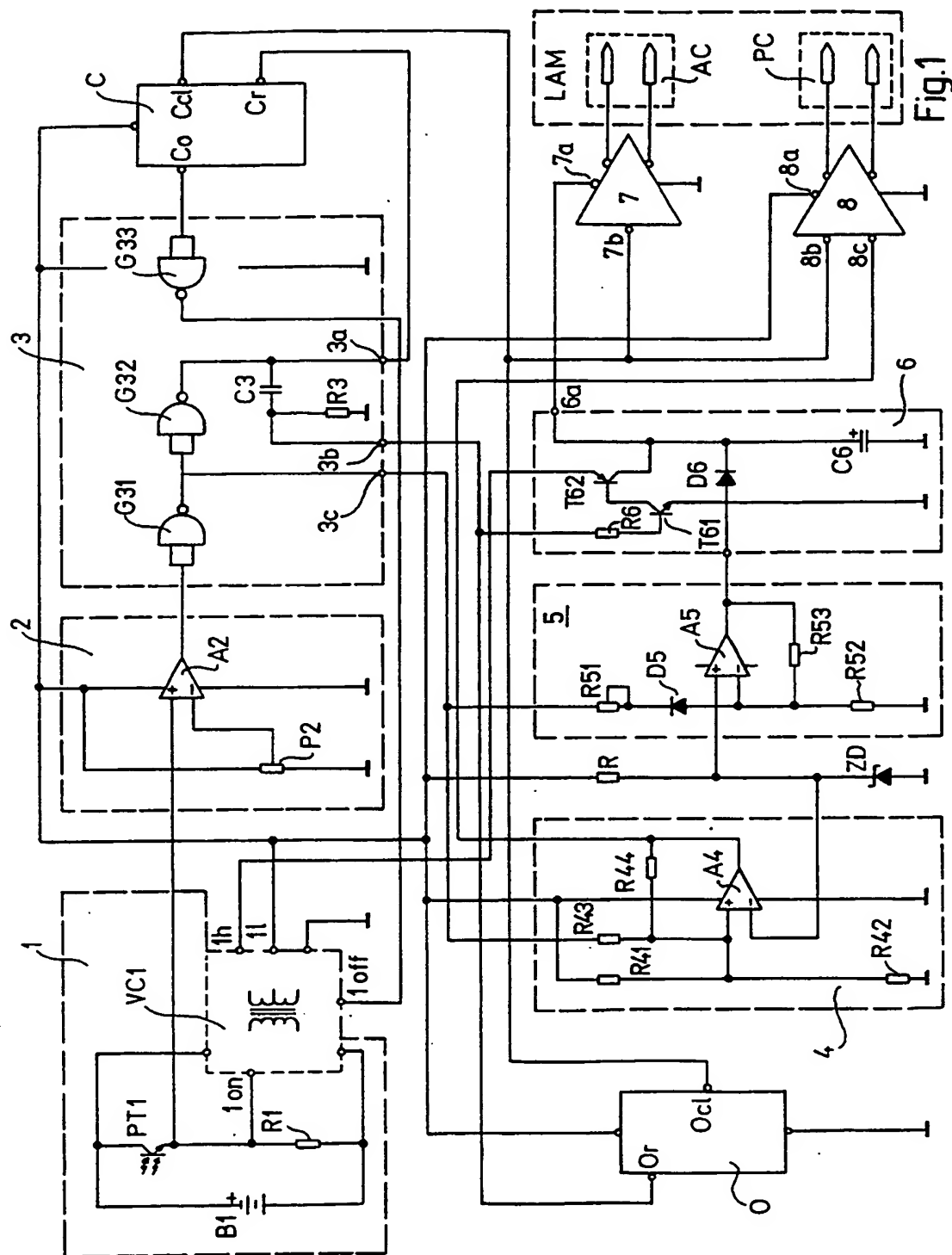
When the welding flashes expire, the voltage on the output 3c of the logic control circuit 3 makes it possible by the amplifier A4 that the control voltage  $U_{PC}$  across the passive liquid crystal cell PC reaches the value corresponding to the first control level U1. At the same time the voltage on the output 3c through the amplifier A5 determines the control voltage  $U_{AC}$  of the fourth control level U4 across the active liquid crystal cell AC. The voltage level U4 is determined by the resistance ratio of the resistors R53 and R52 and follows the temperature dependence of the threshold voltage of the active liquid crystal cell AC since the resistance of the NTC resistor R53 is temperature-dependent. As long as the welding flash continues to last, the voltage on the output 3a of the logic control circuit 3 continues to reset the counter C, which after the switching-off time T through the NAND gate G33 and the terminal 1off of the voltage converter VC1 turns off the whole light switch circuit.

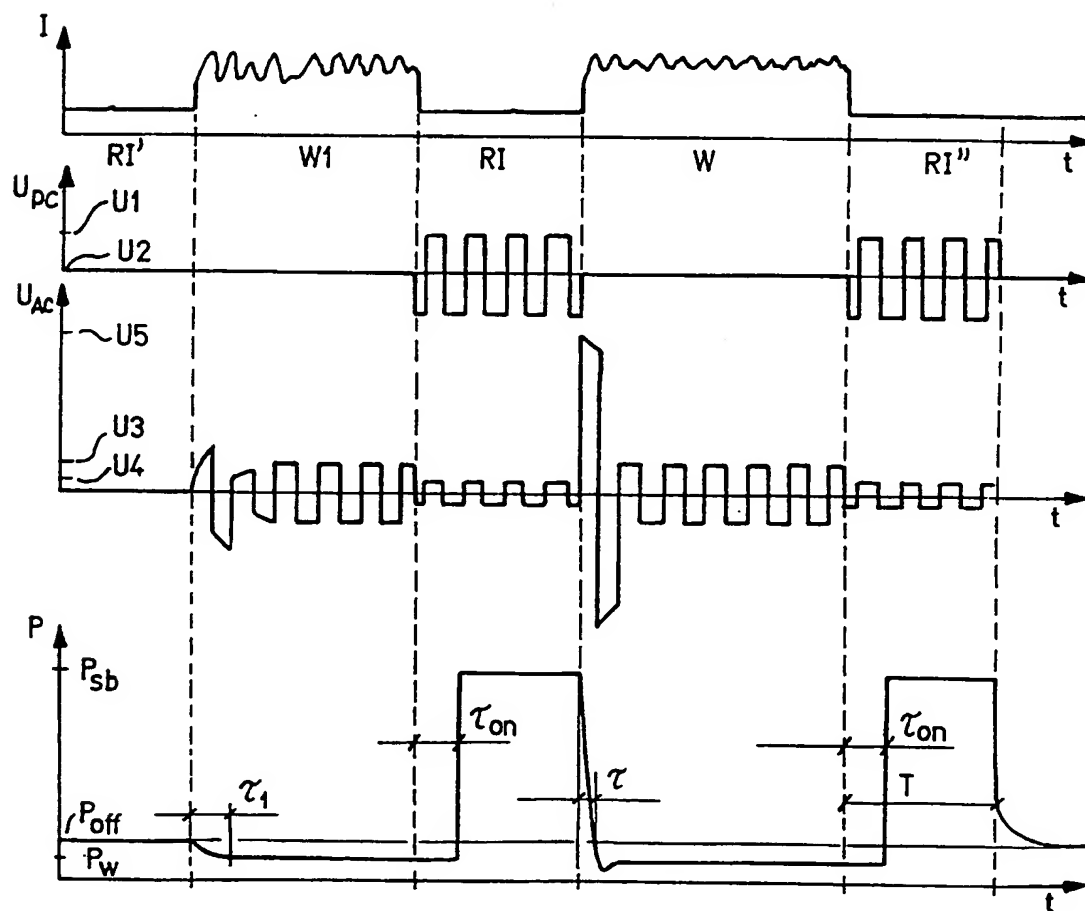
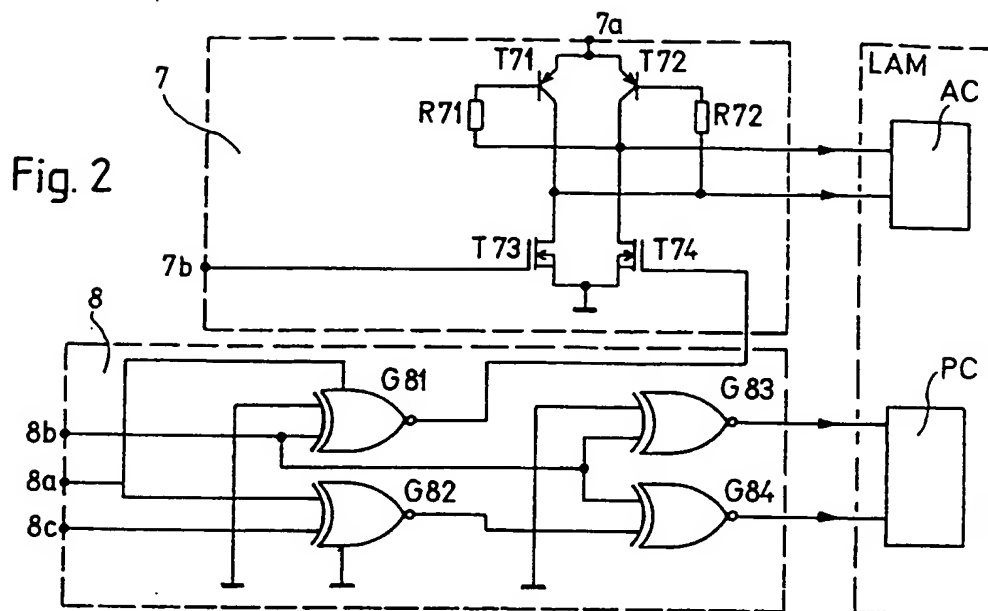
## WHAT IS CLAIMED IS:

1. A method of automatically controlling a liquid crystal light transmission modulator of welding protective glasses according to which across a passive liquid crystal cell (PC), which together with an active liquid crystal cell (AC) constitutes the liquid crystal light transmission modulator (LAM) within a light switch of the welding protective glasses, within a time interval following a termination of welding and being shorter than a switching-off time (T), a control voltage ( $U_{PC}$ ) is applied amounting to the first control level U1 of an alternating polarity and of a constant amplitude, which exceeds the optical threshold voltage of the passive liquid crystall cell (PC) enabling the passive liquid crystall cell (PC) to be in the state of a higher light transmission, otherwise across the passive liquid crystal cell (PC) during welding as well as in the stand-by position following the termination of welding after the switching-off time (T), a control voltage ( $U_{PC}$ ) is applied, amounting to the second control level (U2), which is equal zero and enables the passive liquid crystall cell (PC) to be in the state of a lower light transmission, and across the active liquid crystal cell (AC) during the welding a control voltage ( $U_{AC}$ ) is applied, amounting to the third control level (U3) of an alternating polarity and of a constant amplitude, which exceeds the optical threshold voltage of the active liquid crystal cell (AC), characterized in that across the active liquid crystal cell (AC) within a time interval following the termination of welding and being shorter than the switching-off time (T), the control voltage ( $U_{AC}$ ) is applied amounting to the fourth control level (U4) of an alternating polarity and of a constant amplitude, which is slightly below the optical threshold voltage of the active liquid crystall cell (AC), and that across the active liquid crystal cell (AC) at the start of the welding, which follows the termination of the previous welding after a time interval being shorter than the switching-off time (T), the control voltage ( $U_{AC}$ ) appears amounting to the fifth control level (U5) of an alternating polarity and of a varying amplitude, which in several milliseconds from its initial value exceeding the optical threshold voltage of the active liquid crystall cell (AC) drops for an order of magnitude to the control voltage ( $U_{AC}$ ) amounting to the third control level (U3).

2. A method as recited in claim 1, characterized in that the control voltage ( $U'_{AC}$ ,  $U'_{PC}$ ) across the active and passive liquid crystal cell (AC, PC), respectively, at any polarity inversion continues to be zero for a time interval ( $\tau'$ ), in which the plates of the active and passive liquid crystal cell (AC, PC) are completely discharged to a feeding capacitor in the light switch circuit.
3. A method as recited in claim 1 or 2, characterized in that on the first welding flash the whole control circuit of the light switch is turned on automatically.
4. A method as recited in claim 3, characterized in that across the passive liquid crystal cell (PC), when the power supply battery of the light switch gets worn out, a control voltage ( $U_{PC}$ ) is applied amounting to the second control level ( $U_2$ ), which is equal zero and enables the passive liquid crystall cell (PC) to shift into the state of a lower light transmission.







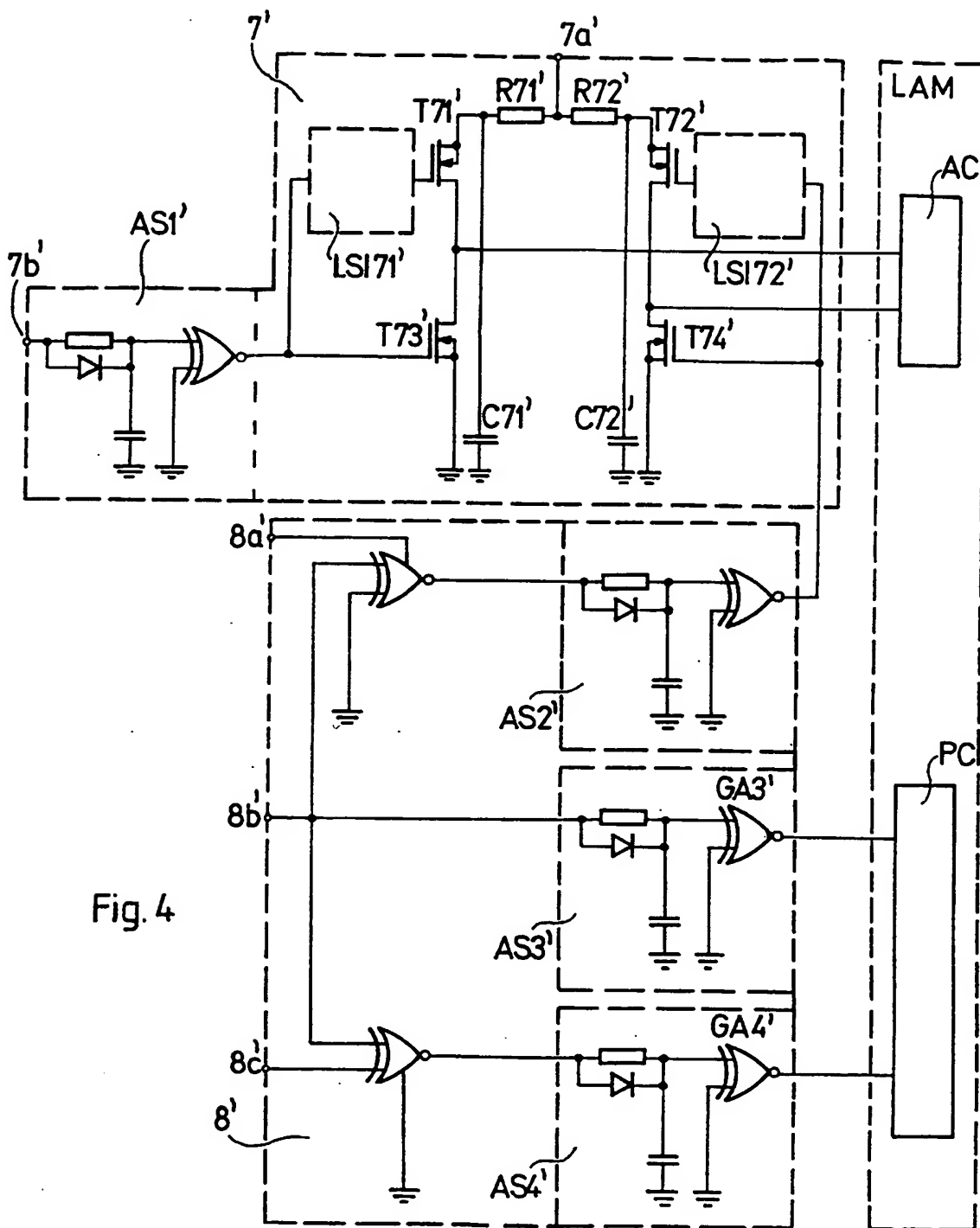


Fig. 4

Fig. 5

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/SI 94/00004

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 5 G02F1/133 A61F9/06 G02F1/1347

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 5 A61F G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 157 744 (TOTH, PETER) 9 October 1985 see page 1, line 21 - page 4, line 20 see page 8, line 14 - line 27 see page 12, line 11 - page 16, line 03 ---	1,3,4
A	WO,A,92 16820 (OSD ENVIZION) 1 October 1992 see page 13, line 08 - page 19, line 02 ---	1-4
A	US,A,3 890 628 (GURLER) 17 June 1975 see column 8, line 01 - column 9, line 54 ---	1
A	EP,A,0 005 417 (HORNELL) 14 November 1979 see page 10, line 15 - page 11, line 10 ---	1
A	US,A,4 039 254 (HARSCH) 2 August 1977 see column 3, line 41 - column 4, line 25 ---	1,3,4
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

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Date of the actual completion of the international search

25 August 1994

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/SI 94/00004

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	<p>US,A,5 181 133 (LIPTON) 19 January 1993  see column 3, line 10 - line 47  see column 4, line 60 - column 5, line 18  -----</p>	2

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PCT/SI 94/00004

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